Performance Measurement for Digital Library Services

Literature review

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1. Executive summary

Aim of this literature review is to draw a picture of past and current research on performance measurement, as applies to digital library services and, at large, to the digital environment, thus consisted of electronic information services and resources. The review starts with a statement of the topic and a tentative definition of digital library to be used as a comparing model for any attempt to measure its performance.

A virtuous cycle of good library management puts users and the provision of quality services to the core of its values. Performance measurement supports this process. Assessment for digital library services is outlined in terms of use, services provided, costs, management tools, added value against the mission and goals of the institution.

In the last decade, novelties brought about by the introduction of digital technologies in libraries have caused efforts converge to devise both new objective models of statistical data gathering and sets of sound reliable measures and indicators, apt to gauge performance. Breaking fresh ground has proved not to be an easy task: lack of consistency, of comparable data, and standards, due to the evolutionary state of the matter, have given birth to a number of initiatives and projects, mainly in the United States and the United Kingdom, which are still looking for common grounds of development. Testing is in progress and crucial to get evidence of appropriateness, reliability and comparability of performance indicators.

At the same time, a number of researchers are looking beyond mere measurement of use of and access, considered too limitative and moving forward to think out new evaluation techniques and a comprehensive view of the digital library. The issue of impact and outcome assessment, in terms of benefits or changes in knowledge, behaviours and attitudes, users can derive from services and resources with potential long-term effects, is the new frontier.

2. Introduction

Recent global developments in information and communication technologies have brought radical changes in the way information is produced, distributed, accessed and used (Chowdhury & Chowdhury, 2003). The digital revolution, in the form of electronic tools, digital resources and networked services, is posing numerous challenges to the traditional role of information mediators played by library professionals, offering, at the same time, exciting opportunities. The adoption of digital technologies has improved library effectiveness and productivity, boosted service and organisational performance, and put forth a compelling rethinking action, aiming at the definition of new models, practices and standards, able to respond to the pressure of a changing environment (Young, 2001).

If an evaluative approach to traditional library services and performance is well established in library culture (Poll, 2001, p. 244), now more than ever, it is essential to facilitate change, by fostering what many authors had already perceived, but not formally stated, and Lakos (1999; 2002) first highlighted by the phrase “culture of assessment”, which he defines,

> an organisational environment in which decisions are based on facts, research and analysis, and where services are planned and delivered in ways that maximize positive outcomes and impacts for customers and stakeholders,

where library services and structures undergo continuous evaluation and are "performance and learning focused".

Since the emergence of digital libraries in early/mid 90s', efforts, funds, research, practical developments and implementations have grown exponentially, while evaluation activities have been lagging far behind. While stressing firmly the need for an ongoing development and maintenance of "coherent and pervasive evaluation strategies" (Bertot, 2004b), both at a research and an operational level, it is widely acknowledged in literature that when getting at the issue of assessment in a digital library environment, much has yet to be investigated. (Saracevic, 2000; Shearer, 2002; Chowdhury & Chowdhury, 2003; Cullen, 2003; Bertot, 2004a).

Evaluation of digital library services may take different perspectives in a manner consistent to the different contexts, needs and priorities taken into account. If one of the core activities of the evaluation process is measurement, it can be carried out, it is assumed, according to a number of methodologies and techniques, responding to well-defined areas of research, aiming at scope and extent of services, be them outputs, outcomes or performance.

Being performance measurement the subject of this review, it is crucial to establish, from the very beginning, the difference and the relationship between this practice and evaluation. Hernon & Altman (1996, p. 16) write:

> The concept of measurement is closely related to evaluation; however, while measurement may lead to evaluation and evaluation may require measurement, the two processes differ. Measurement is the process of assigning numbers to describe or represent some object or phenomenon in a standardised manner. Evaluation, which may include the measurement process, adds components of the research process, planning and implementation strategies to change or improve the organisation or a specific activity.

In the last decade, even if slowly and with difficulty, literature generally has shown that the adoption, and the acceptance of a performance measurement perspective for digital services has brought about meaningful developments of standard indicators, practical definitions, methodologies and procedures helping out libraries coping with the new reality. An overall view on the subject of this literature review will disclose a landscape of many different studies and initiatives, looking into the matter with similar intents and looking into one another for common grounds, still hard to be found.

3. Aim and objectives

Primary aim of this literature review is to outline the factual state of the art about digital library services performance measurement as part of the more comprehensive, but also more elusive issue of evaluation, through the analysis of contributions to research on the subject.

Given the relevant studies produced, the investigations and projects carried out, a set of deriving objectives have been recognised and they are listed as follows:

1. to establish the context of application of performance measures;
2. to set, as far as possible, stable definitions and terms;
3. to identify criteria and methods;
4. to detect the availability, use and suitability of performance measures and indicators as tools of the measurement activity;
5. to investigate the reasons behind any evaluation process, i.e. why bother measuring performance;

6. to assess the feasibility of projects and initiatives carried out in the field;
7. to account, where appropriate, for strengths and weaknesses;
8. to figure out possible future developments and directions of investigation.

4. Standard terms and definitions

That of the agreement on terminology is not a side and ineffectual question. A consistent and uniform application of standard terms and definitions to digital services is the first step to an adequate approach to measurement. Borgman (1999) states that ambiguity of terminology hinders the advance of research and practice and recognises that agreement upon definitions provides focal starting points to work upon. Young (2001a, p. 55) names the relationship between digital services and library performance measurement a "definitional challenge", which "do not admit of easy solutions", because of the heterogeneous state of library technology infrastructures. Urgency of action to establish clear and unambiguous standard definitions and terms is widely recognised.

Progress has been made, thanks also to developments in related areas, like metadata standards, but in literature there is still much use of terms interchangeably, or with different meaning, according to the context they are in (Cullen, 2003; Barton, 2004). Borgman (1999) adds that terminology is directly related to and determines any evaluative framework which is applied. To enhance the evolution of measurement tools, dissemination of procedures, sharing of a common accepted conceptual framework, cooperation and benchmarking, essential to development in a digital environment, it is important to clarify "context-involved terminology" and to show the efforts for internationally agreed-upon definitions.

4.1 Definition of digital library

Reviewing definitions on *digital library*, Borgman (1999, p. 229) finds they start as early as 1993 and indicates that "in general researchers focus on digital libraries as content collected on behalf of user communities, while librarians focus on digital libraries as institutions or services". In this review attention will be paid to the latter approach.

The DLib Working Group on Digital Library Metrics (1998), first, proposed a comprehensive picture, in the form of a summary of headings, giving the following definition:

> The digital library is the collection of services and the collection of information objects that support users in dealing with information objects, and the organisation and presentation of those objects, available directly or indirectly via electronic/digital means.

Stress is put here on the collection of content on behalf of user communities. The concept is made clearer and a crucial step forward is set by the working definition of the Digital Library Federation (1999):

> Digital libraries are organizations that provide the resources, including the specialized staff, to select, structure, offer intellectual access to, interpret, distribute, preserve the integrity of, and ensure the persistence over time of collections of digital works so that they are readily and economically for use by a defined community or set of communities.

The statement is as broad as it should be and the emphasis is on the synergy between the organisational and institutional setting on the one hand and collections on the other, aiming at the provision and the development of services and information resources for a community of users.

The question by Brophy & Wynne (1997), referred to performance measures for the electronic library. They pointed out that one of the difficulties is that this term means different things to different people. Beyond definitions, again Borgman (1999, p. 231) helps to clarify an attitude broadly detected in literature, concluding that apparently the term *digital library*[1] serves as a convenient and familiar shorthand to refer to electronic collections and to electronic or networked information services at large. This review will refer to this broader meaning and use.

4.2 Definition of performance measurement and indicators

Moving from the notion of service quality planning and control applied to effective library management, Poll & te Boekhorst (1996, p. 16) give the following definitions:

> *performance measurement* means collection of statistical and other data describing the performance of the library, and the analysis of these data in order to evaluate the performance […] *performance* is the degree to which a library is achieving its objectives, particularly in terms of users' needs […] *performance indicator* is the quantified statement used to evaluate and compare the performance of a library in achieving its objectives.

It is noteworthy that in the same occasion, they establish the difference with the practice of collecting statistical data, which usually apply to "areas where it is easy to get exact data". Performance measurement, on the contrary, compares and combines data, adds "subjective" data and relates them to the mission and goals of the library (id., p. 18). ISO TC 46/SC 8 (2002, p. 9) definitely confirms and sets this view, also for the electronic and digital environment.

Performance measurement, then, is not simply about collecting statistics, or quantitative data. As an important part of a continuous process of assessment analysis, where users play a pivotal role, it comprises also the gathering of qualitative data about users' opinions, perceptions and satisfaction, in order to keep always a thorough view of compliance with one's mission and goals.

This approach is strongly reaffirmed an year later by ISO 11620 (2003, p. 8), where it reads:

> the performance indicators described […] can be used effectively in the evaluation of libraries. In this process, the quality and effectiveness of the services […] as well as the efficiency of the uses of the resources of the library, are evaluated against the mission, goals and objectives of the library itself.

Performance indicators as tools of measurement serve the scope of effectiveness, quality and efficiency of resources and services and help the fulfilment of stakeholders' interests.

As for the definition of practice, it commonly comes out that the term measurement alternates with assessment and evaluation, even when the last may suggest different or broader activities (Andrews & Law, 2004; Barton, 2004). To conclude, while standards make the effort to

[1] Of course, no confusion must be made between the adjectives *electronic* and *digital*, because as clearly Salarelli & Tammaro (2000, p. 105-108) highlight the first term is referable to the traditional, but automated library using electronic tools to handle data, while the last to data features themselves. Note also the definitions that literature provides, of electronic services or electronic information services, (EIS as they are most commonly referred to). The ISO 2789 *Information and documentation – International library statistics* (2003, p.10) reports the following definition: "electronic library service which is either supplied from local servers or accessible via networks […] comprises the OPAC, the library web site, the electronic collection, electronic document delivery (mediated), electronic reference service, user training on electronic services and Internet access offered via the library", and adds, "the most important electronic service is the electronic collection which consists of digital documents, databases and electronic serials."

state definite meaning of terms, their applications may differ according to context and aim of single initiatives.

5. Digital libraries and the evaluative approach

Primary concern of any evaluative approach is to get information from collected data to be used against a set of defined objectives, which Bertot (2004a) gathers as twofold:

1. Library-centred or system-centred, focusing on efficiency and effectiveness, which is prevalent till now;
2. User-centred, pointing at service quality and users' needs, both cooperating in achieving quality[2].

In this context, Saracevic (2004) adds the following:

1. Human-centred[3] approach, studying behaviour, such as information seeking, browsing, searching or performance in completion of given tasks;
2. Usability-centred approach, assessing features by users, bridging between system and human-centred approaches.

At first sight, performance measurement appears to apply only to a self-contained system-centred approach, which may be, it were not for evidence from literature that integrated research and "multi-faceted approaches" account for successful measurement (Marchionini, G., Plaisant, C., & Komlodi, A., 2003).

This picture raises some additional considerations, when accounting for data collection finalised to measurement of performance in a digital library environment, because of data themselves, their nature and features. Poll (2001a) argues that purposes may be the same as those of a traditional library, but agreement upon what data to collect and what criteria to employ is harder to detect.

5.1 Why performance measurement

Several reasons have been given about why measuring performance of digital services should be adopted as a practice on a regular basis. In fact, Barton (2004) summarises them all defining it a powerful management tool for strategic planning and development, if embedded in the library and its parent organisation management culture.

The stress on management and organisational issues is already traceable in Abbott (1994, cited in EQLIPSE Final report, p. 8), who gives six relevant motives, which may as well apply to digital library services, that is: political imperative, accountability to the parent institution, accountability to customers, service level, quality, decision support.

[2] See the definition of quality as "the totality of features and characteristics of a product or service that bear on its ability to satisfy stated or implied needs" provided by ISO 8402 (1994) *Quality management and quality assurance – Vocabulary*.

[3] Marchionini, Plaisant & Komlodi (2003) deal extensively with this context-based digital library model, where people, information and systems meet. They assert that any evaluative approach has to be customisable to the context taken into account.

Attention to service and users is restated by Poll & te Boekhorst (1996), but always bearing in mind that the first concern, when measuring this kind of "new services", is justification of expenditure and resource allocation (Tammaro, 2000; Poll, 2001). Tammaro (id.) underlines how massive investment efforts, large expenditure in electronic and digital resources and services deserve objective evaluation on service improvements and impact on users to justify expenditure, and Saracevic (2000 and 2004) adds, "to balance the great number of practical developments, applications and research efforts". Again, Saracevic (2000, p. 359) sums it all up,

> performance can be evaluate as to: effectiveness: how well does a system (or any of its parts) perform that for which it was designed?; efficiency: at what cost (costs could be financial or involve time or effort)?; a combination of these two (i.e., cost-effectiveness).

About evidence of good performance through measurement, leading to good management (Davies, 2002), Young (2001a, p. 56) adds that effectiveness measurement and organisational performance are achieved "by assessing needs, testing, identifying gaps & high-risk areas, improving accountability, and by establishing benchmarks and baselines"; opinion sustained by Shim et al. (2001a, p. 20), Blixrud (2003b), Hiller & Self (2004) and by NISO Forum (2001), where three management functions are identified: assistance in internal decision making (purchasing, staffing, etc); justification of library budgets and activities; and, identification of broader trends in the use and value of information and libraries.

A very focused statement about the reasons for performance measurement and consequent application of performance indicators is given by ISO TC 46/SC 8 (2002, p. 9).

> The performance indicators described in this Technical Report are used as tools to compare the effectiveness, efficiency and quality of the library's services and products to the library's mission and goals. They can be used for […]:
> • Comparing a single library's performance over years;
> • Support for management decisions […];
> • Demonstrating the library's performance and its costs […];
> • Comparing performance between libraries of similar structure […];
> • Whether the library's performance or the use of its services has changed over years;
> • How far performance or use in one library differs from that in other libraries.

In relation to library network performance measurement, Bertot (2001a) adds that, apart from helping decision making, measuring and tracking internal changes, users and uses, future collection development and evidence-based services provision, it can ease the transition towards the adoption of new technologies in libraries, competition for institutional funding and comparison on a regional, national level with other organisations.

Attention to the need for collecting statistical data of digital services, when dealing with vendors, is widely reported in literature: Luther (2000) and Blixrud (2003, p. 4) may be cited as examples. Reporting of use, comparison of overlapping coverage, and pricing policies according to actual need and use are here utterly important.

The Scottsdale survey[4] reports two issues to be seriously addressed in the new library environment, for which new performance measures are needed, that is collection development and value-based services. On the last issue, studies have been traced to run parallel with and display a shifting of interest and motives to measuring performance from showing and justifying the good

[4] This survey, distributed among ARL libraries, was named after the town in Arizona, where, during a meeting, held in 2000, the bases of the ARL E-metrics project were laid. It gathered data about the efforts to measure electronic services and resources (Kyrillidou & Giersch, 2004, p. 427).

supporting role of digital services towards their influencing and facilitating changes in learning, parent institutions, scholarly publishing[5].

Literature reviewing reports a positive trend to provide serious grounding to research, both at a national and a local level[6], through initiatives and projects, completed or in due course of development, which besides consciousness of motives have evidenced a number of concerns to work on, and helped build suitable methodologies to devise criteria of approach and appropriate subjects of research.

5.2 Barriers and concerns

There are a number of issues of concern, related to performance measurement of electronic and digital services that need consideration, because they can affect the production of measures and indicators and are responsible for the diverse approaches that have been detected.

Young (1998) identifies the following:

1. lack of standard definitions;
2. unrestricted nature of digital services;
3. addressing obsolescence;
4. rapid changes in infrastructure technologies;
5. rapid changes of pricing models from publishing industry and network service providers;
6. fair use of copyrighted materials in digital format;
7. integration between traditional and digital network activities and services;
8. agreement on standards to be used.

Kena (1998) adds:

1. quality of access;
2. definition of users;
3. costs of data collection.

Other concerns are expressed by Bertot (2001a):

1. accuracy of machine-generated or captured statistical data;
2. limits to longitudinal data;
3. use of new data collection techniques;
4. training in new data collection and analysis techniques;
5. reporting to governing bodies that measuring digital services performance is important;
6. costs and use of consortia-based electronic services;

[5] Literature is wide on the subject of impact and outcome assessment on research, learning, and institutions. It goes beyond the scope of this review, but as instances, see Ford, 2001; McClure & Fraser, 2002; Bertot & McClure, 2003; Poll, 2003; Bertot, 2004a.

[6] Notable local examples among research libraries, as reported by Hiller & Self (2004), are those taking place in the United States, like the Data Farm of the University of Pennsylvania, which is a repository of quantitative data, used both for collection and presentation. It includes locally produced data, survey reports, database and e-journal use, because the library has chosen not to rely on vendor statistics. To accomplish this strategy, the library has built measurement devices into its local architecture. The University of Virginia has appointed a Management Information Systems Committee responsible for assessment, data collection, usability testing and reporting, while, in the late 90s', the University of Arizona developed the Performance Effectiveness Management System (Stoffle & Phipps, 2003) to monitor and gather, on a regular basis, data to be used to set standards and performance targets in any library activity and service.

7. partnership.

Kyrillidou & Giersch (2004, p. 429) report on persistence of barriers to a full development of standard consistent performance measures and indicators to be applied:

1. lack of consistency across resources;
2. lack of comparable data for print resources, offline services;
3. lack of consistent longitudinal data/studies;
4. lack of consistency across institutions;

and recognise that "impediments to collecting data included a lack of recognized methodologies for evaluation and vendors resistant to providing […] with accurate and detailed statistical information".

Three main issues seem to stand out from the above list: reliability, accuracy and comparability of collected data, also summed up and pointed out in ISO TC 46/SC 8 (2002), the achievement of which has led efforts to devise methodologies and techniques and made room for initiatives, guidelines and best practices, intended to support librarians in their performance measurement activities.

6. Performance measures and indicators for digital library services

6.1 Measurement criteria framework

As Hiller & Self (2004) observe "The task of writing indicators and measuring performance turned out to be a complex activity with mixed results at best". This is easily found out when trying to sketch out a general assessment framework, if any, beyond individual results obtained by the different initiatives and projects carried out mainly in an Anglo-American environment.

The tentative attempt to gather, from the literature, some recurrent components or categories and criteria, concurring to draw an overall picture of the performance measurement practice would eventually lead to the identification of a general model as a starting point for the definition of measures and indicators. It is noticeable that the models under study sometimes overlap, sometimes differ.

McClure & Lopata (1996, cited by Brophy & Wynne, 1997) consider the following components, giving a quite comprehensive picture:

> *users*: the number and types of users of the network and the frequency of their use
> *costs*: the total and types of financial resources necessary to operate the network
> *network traffic*: amounts and types
> *use*: amounts and types
> *services*: the applications which are available on the network
> *support*: the types of assistance which are available to network users.

Brophy & Wynne (1997) build a model for the MIEL programme[7], taking into account the following categories: stakeholders, resources and services, functions of the electronic library, sources of data.

[7] The project was carried out by the Centre for Research in Libraries & Information Management of the University of Central Lancashire, part of the Management Information for the Electronic Library Programme.

Relating to her analysis to the EQUINOX project, Poll (2001) groups the following components from which performance indicators are developed: market penetration, provision and use of electronic services, user support, human resources and costs.

In their project for the development of national network statistics and performance measures for US public libraries, Bertot, McClure & Ryan (2000) identify components as follows: a technical infrastructure (hardware, software and all technical aspects); information content (resources available); information services (to complete tasks and activities); support (assistance provided); management (human resources, governance). In the context of ARL E-metrics project, Miller & Schmidt (2001, p. 10) confirm three of the above given categories, that is, information content, information services and technical infrastructure.

The above examples suggest there is a strong effort (conscious or not) towards convergence of starting points. The next step about the definition of criteria and the formalisation of deriving performance measures is a more critical one.

Criteria are of great concern to researchers working to define a self-sustaining assessment framework. They are not usually devised on purpose, but transferred from a traditional environment and then adapted, which in time has proved to be not a very successful approach. As ISO TC 46/SC 8 (2002, p. 5) notes, "boundaries within which services operate differ from those in which traditional library services operate", secondly the standard warns, "the ability to measure the usage of publications in electronic format differs radically from that associated with print formats".

In any case, the attempt to confront the two settings and to work on their integration and the transition to a new model cannot be dismissed as pointless. Saracevic (2000) gathers evaluation criteria on performance, identifying those deriving from:

1. the traditional library (collection, information, and standards)
2. information retrieval (relevance, satisfaction and success)
3. human-computer interaction environment (usability and functionality).

In mid 90s' a model evaluation project, still considered valid for accuracy and completeness, was developed for the Perseus project[8]. Marchionini, Plaisant & Komlodi (2003) report that four evaluation criteria were identified: learning, teaching, system (performance, interface, electronic publishing), and content (scope, accuracy), which led to establish four categories of study: amplification and augmentation of learning, physical infrastructure, conceptual infrastructure, and systemic change.

There are a number of critical gaps left open by the above analysis. An attempt to fill them out, even if not completely, is provided by the research conducted by Bertot, McClure & Ryan (2000) in the United States. They identify:

extensiveness: service provided in numbers;
efficiency: the use of resources in providing or accessing networked information services;
effectiveness: how well the service meets the objectives of the provider or the user;
service quality: how well a service or activity is done;
impact: how a service made a difference in some other activity or situation;
usefulness: the degree to which the services are useful or appropriate for individual user;

[8] The Perseus project is intended to improve access to a corpus of multimedia primary source materials and tools, related to the ancient Greek world, offered to students and academics to better learn and understand that culture.

adoption: the extent to which institutions or users integrate and adopt electronic networked resources or services into organizational or individual activities.

The authors express concern about indicators in key evaluation criteria of impact and usefulness, and warn against the danger of relying solely on technology to get counts. Transaction logs, counts of equipment usage have proved not to be always suitable. They may not be accurate, because machine-generated and sometimes set to commercial standards (Galluzzi, 2001, p. 9). If, then, performance indicators are weighed against, not only the quantity, but also the quality of library services they are to measure, as Poll (2001) remarks, they don't always come up to this claim, when they merely measure the amount of resources allocated to digital services (extensiveness), or at best efficiency and effectiveness. Bertot (2000a) recognises there are a number of issues which request further research and areas of study like that of methodologies to be applied.

6.2 Measurement methodologies and data collection techniques

"It is imperative to ensure efficient and effective data collection", (Walton, 2003, p. 4), that's why methodology must be rigorous when coming to performance measurement. Traditionally, much of the research on performance measures has been concerned with quantitative measures. However, Bertot & McClure (1998) suggested using a combination of quantitative and qualitative methods because of the complex nature of electronic networked services, while Brophy & Wynne (1997) considered that the qualitative management perspective was valuable if concerned with the impact as well as the extent of use of electronic services.

Authors generally agree on the adoption of both quantitative and qualitative methods, the last drawn from social sciences (Tammaro, 2000; Galluzzi, 2001; Wood 2001; Barton, 2004 as examples). Kyrillidou & Giersch (2004) talk properly about "rich methods" as a way to provide a better and more reliable picture of the complexity of digital services. They provide a more powerful approach, because arising from the combination of both types of research methods (Bertot, 2000, p. 65), which by "the use of multiple data collection techniques may allow the evaluator to cross-check the results and increase credibility and reliability" (McClure, 2001, cited by Kyrillidou & Giersch, 2004). While a quantitative approach may help the building-up of dependable statistics, the qualitative one may help the attentive reading of those data and explore further the whys and hows of behaviours, perceptions and uses.

Collection techniques devised by Bertot, McClure & Ryan (2000), also cited by other authors in the same period, applicable to electronic network services, but extendable to the whole of digital library services, are:

1. qualitative: case studies to explore selected communities; content analysis to review historical development and get future directions; critical path analysis to explore users' interaction with services and resources; individual and small group interviews to explore content, performance and services with users and administrators and focus groups; observation; user-written diary/protocol placed at the workstation (suggested among others by ISO 2789).
2. quantitative: mail and electronic surveys to reach a broad population segment; web-based or pop-up surveys to explore a particular portion of a web site; network traffic use statistics, such as access points, server loads, web downloads times, and web

server log files analysis[9], new valuable technique allowed by technology developments, whose use must be very careful as to accuracy or depth of data.

6.3 Features of performance indicators

Studies have also evidenced the need to select some prescriptive or recommended features as being proper to the indicators against which measurement is performed. They have usually been created and adopted according to compliance with these features and testing always looks back on to them, because regarded as assurance to successful employment and good results.

The features selected by Poll & te Boekhorst (1996, p. 18) for a traditional library, but certainly transferable to a digital one, are:

1. appropriateness or validity for what the indicator is supposed to measure;
2. reliability or accuracy, that is, it consistently produces the same result when used repeatedly under the same circumstances;
3. reproducibility, that is, same score means same level of quality of services or efficiency across different libraries;
4. helpfulness or usefulness in decision-making, in showing users' needs;
5. practicality or user friendliness to further its acceptance.

The last criterion is not regarded as a fundamental one.

Features put forth by the international standard ISO 11620 (2003, p. 6) differ in some points, even if the general framework. ISO 11620 names differently helpfulness, changing it in informative content, and reproducibility in comparability, but retains the meanings. It, then, separates appropriateness from validity, adding a new criterion, because appropriateness is meant according to the purpose of the indicator itself and validity remains for what the indicator is supposed to measure. A slightly different meaning is given to practicality considered as availability of data with a reasonable effort on the side of the library and users.

ISO 11620 extends indispensable features of performance indicators from four to five, because considers comparability only recommendable, just in case this approach is assumed as important by the library, and gets more precise as regards meanings and explanations.

7. Initiatives and projects: what to measure

A number of projects and initiatives, designed to improve the availability of consistent and comparable statistical data and to establish accurate and reliable performance indicators to be used in performance measurement in a digital environment, have been undertaken over the past several years. On the whole, each and any of them bring an important contribution to the development of the matter and enhancement of studies. At the same time they show a lack of communication and coordination among them, which in time has resulted in important achievements at the level of

[9] Jones, S. *et al.* (2000) explain how it becomes important to investigate the ways in which users interact with digital library systems in practice. Transaction logs are a most appropriate source of usage information. They confide information on user behaviour can be drawn from them both automatically (through calculation of statistics) and manually (by examining query strings about searching strategies, like the use of operators and search options to understand search motivations). Bollen *et al.* (2003) add that the analysis of user logs helps assess research trends in institution's user communities and what parts of a collection are most valued.

national groups, but in confusion, at an operational level, for those organisations keen on adopting practices, but not directly involved in the deployment of results.

In Europe and in the United States, the last ten years have seen the birth of standards, initiatives and projects in an academic and public library environment, and collaboration with vendors of electronic and digital products in the effort to devise what is really worth measuring.

7.1 Standards

Current standards for the collection of statistics in libraries are proposed by ISO TC46/SC8, section of the International Standards Organization (ISO 2789 and ISO 11620) in Europe, and the National Information Standards Organization (ANSI/NISO Z39.7) in the United States.

They are specifically studied to operate at a national and an international level, and "serve both informational and definitional purposes that enable the aggregation of library data across a number of libraries" (Shim et al., 2003), mirroring, in this way, the very nature of digital services, whose hazy boundaries are not easily devisable at a single library level (Tammaro, 2000; Shearer, 2002).

Prepared also by the results and concerns of LIBECON2000 project[10], ISO 2789 on international library statistics in its new 2003 release adds an important annex on "Measuring the use of electronic library services", where guidelines are given to address correctly, from a technical point of view too, issues regarding electronic collections and use. Among the drafters of the revision, Sumsion (2002) highlights the emphasis given by the standard to use and users[11], and to integration, as services are integrated in a hybrid library[12].

ISO 11620 on performance indicators collects 32 indicators regarding user perceptions, public and technical services. It addresses, not only the quantity, like any statistics may do, but also the quality of provided services, and indicators are recommended but not prescriptive, because it is up to the library to decide what indicators are appropriate to its goals (Toni, 2005).

Most notable is the integration of the two standards with the technical report 20983 by ISO TC46/SC8 work in progress, which produced 15 new indicators[13], purposely identified for a digital

[10] LIBECON2000 is a project funded by DG13 of the European Commission, which run from 1999 to 2001. It collected and published on its web site library statistics of 29 European countries. Reporting on its achievements, Fuegi (1999) foresees how its future is related to widening the range of its data collection and definitions to new IC technologies.

[11] Counting uses and defining users is a challenging revolutionary task in a digital environment. As Poll (2001b) notes, citing ISO standards, data have to be collected from different sources, definitions of queries proves difficult, too and it is also very uneasy to distinguish between direct and indirect users, when it is important to justify expenditure and costs.

[12] As regards performance measures for integrated traditional and electronic services in a hybrid library, it is noteworthy what Jackson (2001) refers about The Hybrid Library of the Future project (HyLiFe) funded by JISC in the UK. The project is about how best to deliver the mixture of print and electronic services likely to be required of higher education libraries in the foreseeable future. "The project established, tested and evaluated a knowledge of operating practices for the 'hybrid library', which were then disseminated to the wider HE community. Research was carried out on how to integrate delivery of large-scale print and electronic services behind an electronic interface".

[13] The list reads as follows (id., pp. 12-13): Percentage of population reached by electronic services; Percentage of expenditure on information provision spent on the electronic collection; Number of documents downloaded per session; Cost per database session; Cost per document downloaded; Percentage of rejected

environment. The report recognises its limitations by evaluating only "performance by quantitative statements about the supply, use, costs, or market penetration of electronic library services" (ISO TC 46/SC 8, 2002, p. 10), while it refers back to ISO 11620 for the collection of qualitative data, namely on user satisfaction.

According to contributors to the 2001 NISO forum, the 1995 edition of Z39.7 on performance indicators for electronic library services relied too heavily on collecting inputs and outputs, and was thought to be insufficient in two major areas: the measurement of electronic resources, and the measurement of service quality (NISO Forum on performance measures and statistics for libraries, 2001). In fact, 2004 revision brings an appendix on measurement of electronic services. By its own admission, it draws heavily from the ISO standards, absorbs definitions and takes into account other relevant resources put forth by other organisations, de facto recognising their value by gathering them. "The value of this approach is that it recognizes the guidelines and best practices in the area of library statistics across the community, not only at the national survey level" (NISO Z39.7 Foreword, 2004).

7.2 Academic, public libraries and other organisations in Europe

While many organizations ground their surveys on these standards, there exist initiatives by various local, national and international associations, whose approach differs depending on organisational purposes or budgetary concerns. Both in Europe and in the United States a number of interesting projects have been developed. Here only the most significant ones will be reviewed.

In the United Kingdom, as early as 1996, the eLib programme, founded to shape and accelerate the development electronic media and network services in UK higher education libraries, had among its aims: improving access to information in a cost-effective way, and increasing library performance.

One of the oldest projects, which both gathered previous works[14] and broke new grounds, was the so-called MIEL2, whose final report by Brophy & Wynne was published in 1997. The performance indicators are proposed starting from the assumption that hybrid library services are operated. They are established combining library functions with managerial tasks, like operational and strategic management and forward planning. The issues raised like user satisfaction, delivery, efficiency and economy of services are adapted to an electronic environment.

Another research endeavour into measuring electronic services is represented by the EQINOX project, funded under the European Commission's 4th Framework Programme and conducted between 1998 and 2000. Starting from the conclusions reached by the previous researches, it delivered the following outputs: a set of performance indicators, a software tool, an

sessions; Percentage of remote OPAC sessions; Percentage of virtual visits to total visits; Percentage of information requests submitted electronically; Number of user attendances at electronic service training lessons per capita; Number of workstation hours available per capita; Population per public access workstation; Workstation use rate; Number of attendances at formal IT and related training lessons per staff member; Percentage of library staff providing and developing electronic services.

[14] Namely, the EQLIPSE project and concerted action CAMILE on evaluation and quality of library performance and information management by the Commission of the European Communities; ISO 11620 (1995 release); IFLA guidelines for performance measurement in academic libraries; McClure & Lopata manual *Assessing the academic networked environment: strategies and options* (1996); EAL report on performance indicators for UK academic libraries by the Joint Funding Councils (Brophy & Wynne, pp. 4 and 13).

XML DTD[15]. Performance indicators designed by EQUINOX are intended to complement ISO 11620, not to replace it[16], with the purpose of achieving beyond performance, quality management by using the ISO 11620 "user satisfaction", always in conjunction with the other indicators. Literature doesn't report on practical applications of the project. In Germany, where it has been applied, tests proved it hard to show quality out of the indicators accounting for percentages and numbers. Counting use showed difficulties, too, deriving from the different sources of collection. At the end, among German libraries it was agreed upon to use an adaptation and to stick to accesses and views counts (Poll, 2001a).

The E-measures project, started in 2003 and to be completed by 2005, is run by the Library Services of the University of Central England, in conjunction with the SCONUL[17]. The aim is to produce a set of statistics for measuring electronic information services in UK higher education libraries for decision-making and user support. The project is based in evidence and practice. Measures are studied and tested in and for libraries. Two main issues have emerged out of the investigated measures on provision of stock, use of services and costs: the "cost per use" figure, already suggested as auspicious by Poll (2001b), is taken as a very important one, even difficult to achieve (Conyers, 2004a); the "virtual visits or hits on the library web site" figure has proved to be equally an elusive one. The project is notable in its aims and planning, but it is too early to consider its positive outcomes.

The purpose of the eVALUEd project, started in 2001 and completed in 2004, goes beyond performance measurement to pursue outcomes assessment in relation to electronic information services provision (Thebridge, 2004). It develops an online toolkit to ease e-libraries qualitative evaluation in UK higher education (McNicol, 2004). It focuses on users' opinions, impressions and use. It is designed to help the toolkit users easily through the time-consuming process of data analysis, without dismissing statistical data collection. The intention of developers is to release a help for institutions to start or enhance their assessment practices, according to their needs, without any ready-made solution. According to identified areas of research, it proposes possible evidence to support outcomes and the related data collection methods with sample tools (Thebridge, 2003).

As far as the Italian scenario is concerned, literature doesn't give back notable projects going on comparable in extent and devoted resources to those detected at an international level. There have been initiatives like the CASPUR[18] seminars, hosted by Bibliocom, which have raised the issue of digital services performance measurement from an operational point of view (Gargiulo, 2003; Sforzini & Scarnò, 2003), grounding research on the analysis of raw usage data extracted from file logs, to back decision-making and on web surveys to get to know users, their needs, their attitudes towards paper-based versus electronic resources (Farinelli, 2003). CILEA consortium[19] activities on measurement (Rodi, 2003; Dellisanti & Balducci, 2004) concentrate on getting statistics from access and full-text article download counting and performance indicators built on

[15] According to developers, the software is a decision support tool to aid the library manager to implement performance measurement and quality management practices (Brinkley, 2000), while the XML Data Type Definition is designed to assist interoperability of management data to be uploaded in or downloaded from the software (Brophy, 2001).

[16] The EQUINOX project devised 14 performance indicators, to get to measure. Poll (2001c) resumes: users reached, work sessions, documents viewed, costs, user training, staff devoted and user satisfaction.

[17] The Society of College, National and University Libraries produces the Annual Library Statistics, where to possibly report the set of e-measures developed by the project.

[18] CASPUR provides support to the CIBER consortium of South Central Italy University libraries (Inter-university coordination database and web publishing - Coordinamento interuniversitario basi dati ed editoria in rete). CIBER's goal is to share all activities relating to bibliographic and documentary electronic resources online access, in order to improve services by rationalizing the resources and applying economy of scale.

[19] CILEA is a consortium of Northern Italian University libraries.

cost per use, use per FTE and cost per FTE. Figures are then shared among consortium partners to be used again for managerial decision-making. There are also some notable initiatives by single University libraries, like the University of Parma, or Milano-Bicocca. For instance, the latter started to think out approaches to remote electronic resources measurement, because as Di Girolamo (2002) recognises a gap needed to be filled out. Civardi, Maffenini & Zavarrone (2002) conducted a survey among researchers and scholars to search for efficiency and cost-effectiveness of services, and a project for a data warehouse software was developed with the aim to collect in the most efficient way quantitative data on the institutional use of electronic resources (Di Girolamo, 2003).

7.3 Academic, public libraries and other organisations in the United States

The United States offer a wide, very in-depth suite of interesting projects carried out at national level, both in the research and public library sector and by government agencies. They are extensively tested, reported and disseminated.

In the public library sector, between 1999 and 2001, an important study funded by the Institute of Museum and Library Services and conducted by Bertot, McClure and Ryan, which produced journal articles, conference papers, a web site and ended in the publication of a manual (2001). It proposed a set of data elements, namely databases, virtual visits, electronic services, training, workstations, needed to produce statistics and possible performance measures a networked environment. The how-to-do manual points out, then, at an operational level, the steps towards a successful assessment of one's own library networked services. It starts with the collection of the above-mentioned "hard", statistics to continue with the set of related measures, establishing percentages, levels of services and totals, to finish with suggested assessment methods and data analysis.

The ARL E-Metrics project is, by its own definition "an effort to explore the feasibility of defining and collecting data on the use and value of electronic resources". The project, which began in 2000 and ended in 2001, was funded by 24 ARL libraries and was carried out in three distinct phases (Miller & Schmidt, 2001). The first phase was spent in gathering information about current practices to document the state-of-the-art among ARL libraries and in external contexts (Shim et al., 2000; Shim, McClure & Bertot, 2000). The findings helped the transition to the next operational phase, employed to analyse challenges, define and test a set of proposed measures in four areas: 1. patron accessible resources; 2. use of electronic resources and services; 3. expenditures for networked resources and related infrastructure; 4. library digitisation activities, which after field-testing and consideration were expanded to electronic reference transactions, percentage of virtual visits and e-books (Shim et al., 2001a). Moreover, a Working Group on Database Vendor Statistics was appointed to investigate how to gather data from vendors' databases, which later led to support project COUNTER (Blixrud, 2003b). The last working phase set the pace of future investigations about library measures linked to institutional outcomes (Blixrud, 2002), and the development of some areas of concern like staff training in performance measurement and understanding the importance of assessment.

Also notable are the initiatives of governmental agencies like CENDI, which concentrated efforts in devising common definitions for web metric usage, evaluation of user satisfaction and performance. In particular, performance metrics measure the speed and efficiency of providing the information, whether displaying a page, downloading a file, or performing a transaction (Hodge, 2000). Unfortunately the project has not moved on from a preliminary phase, whose findings are nevertheless useful.

7.4 Libraries and vendors

It appears that one of the major concerns, when gathering data about digital services, namely use of resources, is to provide accurate usage data. Luther (2000) in her study, commissioned by CLIR, observes how libraries are more and more dependent upon publishers and aggregators, how available data vary among vendors, how they provide little information about data collection and how librarians are unclear about what they actually need. She detects a lack of comparable data, context to apply consistent measures, fair pricing models, limitations of content provided and barriers to access. Luther recommends a standard methodology for collecting and analysing data, "to ensure that both publishers and librarians have comparable and reliable data". Town (2000), on the other end, dismisses the activity of counting usage as "pointless", because libraries don't actually have any power or control on these services.

Researches have been conducted to verify if library-collected usage data correlate with vendor-provided data. Duy & Vaughan (2003, p. 21) prove that while locally gathered data are fairly similar to those provided by vendors "in terms of patterns of use", they do not provide the same quantitative values. What is more trustworthy can still be matter of investigation.

The above-sketched picture shows how valuable initiatives are, which aim to find common grounds to work upon, like the ICOLC Guidelines, last released in 2001 and standard measures set out by the COUNTER project.

The International Coalition of Library Consortia intention is to provide a practical framework to deliver standard network usage statistics and reporting systems of vendor data. Guidelines do not prescribe methodologies or definitions, but give simple minimum requirements, that is, number of sessions, queries, menu selections, items examined.

In 2000 the Publisher and Library Solution Committee (PALS) set up a Working Group in the UK in conjunction with JISC, to tackle the issue of common standards development. A Code of Practice was proposed and an international discussion forum organised, which led to the birth of the COUNTER project, which by January 2006 will publish release 2 of the Code of Practice. COUNTER compliant resources are growing and compliance is becoming a mark of assurance and quality. Shepherd (2004) observes that success is determined also by clear basic aims, that is simple metrics[20], start with journals and databases, as they are the most used resources, a prescriptive approach, an extensive list of definitions of terms, auditing of vendor usage reports and a standard report delivery. In any case, Tenopir (2005) argues that achievements can be improved by producing comparisons across vendors, analysing a year's worth journal use to get a wider picture, by adding prices in reports for each system or database as to calculate relative cost per use. To conclude, it is critical, then, to consider together use data, cost per use and size of the user population.

8. Future directions

[20] COUNTER Code of Practice (2005) on usage reports cites the following: Journal report 1: number of full-text article requests by month and journal; Journal report 1a: number of successful full-text requests in html and pdf formats; Journal report 2: turnaways by month and journal; Journal report 3: number of item requests by month, journal and page type; Journal report 4: total searches by month and collection; Database report 1: total searches, sessions and full-text requests by month and database; Database report 2: turnaways by month and database; Database report 3: referral by aggregator or gateway.

Digital library services are, of course, expected to evolve, if only because of inevitable technology enhancements. Evaluation at different levels will certainly follow. As Hiller & Self (2004, p. 144) put it "As digital libraries mature, assessment may well receive a higher priority".

As for performance measurement, researchers are aware there are various areas where future actions are needed, but at the same time have reached enough skills to perceive that further steps are needed. Poll (2005, p. 2) remarks, "measures have been developed to assess the quality of library services and the cost-efficiency of library performance. But quantity of use and quality of performance do not yet prove that users benefited from their contacts with a library". Literature proves that possible developments will be shifting interests towards new correlated fields.

Kyrillidou & Giersch (2004) pinpoint four areas of investigation, which are seriously addressed to by ARL through a series of parallel initiatives[21]. In a way, they sum up current research trends:

1. enhancing of webmetrics methodologies and measurement tools;
2. further investing in the COUNTER Code of Practice;
3. evaluating electronic resources from a user perspective;
4. evaluating their use with an eye to purposes.

Bertot & McClure (2003, p. 605) assume that, generally speaking, libraries are not mature to demonstrate how much they contribute to the accomplishment of their parent institution outcomes. It is something to work on, then. On the other hand, Poll (2003; 2005) reminds how foreseeable interests appear to be driven by the need to assess the effects of digital services on users, the benefits, the impact or outcome they produce, because, in the end, value is the scope, but, she notes, testing the effectiveness of methods still requests much work.

9. Conclusions

When Cram (1999) states "developing a performance measurement regime that balances the notions of efficiency and effectiveness with the resulting benefits to customers is critical to the survival of libraries and crucial for positive strategic development of library services", it is not just applying old ways to new realities. To the contrary, literature scanning has proved that the push to study the subject in relation to digital services comes from this acknowledgement. The diverse-perspective approaches, the intense debates, the applications, the shifting towards new correlated research fields, all prove that the matter is vital, that there are still margins to development and refinement of procedures and further research.

What future directions performance measurement for digital library services may take, it is hard to foresee. It will certainly progress, as technology does, both for the definition of procedures and the application tools. As for now, it may be concluded that there is not just one model or approach, or a set of indicators suitable for any context. Literature seems to show that, if the

[21] The authors refer to: a keener attention to the market for software packages able to help in analysing web log data; the LibQUAL+™ suite of services intended for libraries to investigate users' opinions of service quality, evolving now towards E-QUAL, an attempt to address perceptions of digital library service quality; the MINES for Libraries protocol is "an online transaction-based survey that collects data on the purpose of use of electronic resources and the demographics of users". About MINES Plum (2005) argues that it may become in the near future the counterpart answer to vendor-provided usage data by running all access for networked electronic resources through a gateway that authenticates access and registers requests.

premise to any research is the pursuit of standards, as the right response to measurement practices, conclusions show that any tool, any possible practice has to be tested to prove effectual for the particular reality under measurement. There are standards, of course. They do the immense job of giving guidelines, but to be truly effective, they must be continuously improved through practice and further research and this is not the whole picture yet.

Kyrillidou & Giersch (2004, p. 438) say "[…] in order to discover whether a user has successfully used an electronic resource, we need to instigate a transaction that will help us understand whether the information discovery process has truly led to knowledge discovery". If performance measurement, then, is about numbers and counts, it is true that to make sense out of them, to help the process towards the ultimate purpose, that "knowledge discovery", which justifies a library's existence, it is vital the application of mixed assessment methods, deriving also from qualitative research and it is also most important the direction investigations are taking towards impact and outcome measurement of digital services on users' communities.

10. Critical account

Primal concern of this work is to detect and gather shared visions beyond diverse operational results, but also to establish focal points of investigation as guidance through the analysis of the subject, which are set as follows.

10.1 Data collection

The identification of relevant resources for this review and the collection of data have been strongly affected by the very nature of the subject dealt with, both as for source tracing and for the source type considered:

1. Source tracing tools: online scholarly databases, research projects, web search engines and web bibliographies.
2. Source type: journal articles, glossaries, standards, reports, websites, white papers and guidelines.

A consistent part of documents and information has been retrieved online, either freely available on institutional web sites of organisations or research projects, interested in disseminating their activities and the results of their research or hosted by databases and electronic journals.

Information retrieval has started on bibliographic databases and web search engines, by using the key phrases, their synonyms and related terms identified in the aim, used both separately and in combination:

Digital library services	electronic library library e-service* electronic information service* electronic resources electronic library service* network* service* networked environment network* information service*

Performance measures and indicators	performance measure* performance evaluat* performance assessment evaluation e-measure* performance standard* statistics standards quality standard*

Materials have then been evaluated according to content, internal notes, references and web site links, in order to track down a thread of recurring issues, authors, projects and standards. Data collected suggest a volunteer and dynamic effort towards building up a "community of interest" around the matter of standards for digital library statistics and performance. Of course, conferences, journals, online news services help community building. It is worth observing that, apart from institutional web sites, purposely dedicated to projects, standards, toolkits and testbeds, such as the *IFLA Statistics and Evaluation Section*, the *DELOS wp7 on evaluation,* the *International Standards Organization (ISO)*, the *(US) National Information Standards Organization (NISO)*, a scholarly journal, *Performance Measurement and Metrics,* is entirely dedicated to library performance measurement and hosts contributions focusing on digital libraries. Since 1995 the biennial *Northumbria International Conference on Performance Measurement in Library and Information Services* is being held with the intent to bring together researchers, educators, and practitioners in and around the world to set the state of research going on. In particular, the 3rd and 4th conferences had as dominant discussion themes: the evaluation of digital library services and the measurement issue at different levels.

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